

Claims

What is claimed is:

1. An aircraft gas turbine engine turbine frame comprising:
 - 5 a first structural ring,
 - a second structural ring disposed co-axially with and radially spaced inwardly of said first structural ring about a centerline axis,
 - a plurality of circumferentially spaced apart
 - 10 struts extending radially between said first and second structural rings,
 - forward and aft sump members having forward and aft central bores,
 - said forward and aft sump members fixedly joined
 - 15 to forward and aft portions of said turbine frame respectively, and
 - a frame connecting means for connecting said engine to an aircraft disposed on said first structural ring.
- 20 2. A frame as claimed in claim 1 wherein said forward and aft central bores are cylindrical.
3. A frame as claimed in claim 1 wherein said frame connecting means includes at least one U-shaped clevis.
- 25 4. A frame as claimed in claim 3 wherein said forward and aft central bores are cylindrical.
5. A gas turbine engine assembly comprising:
 - an inter-turbine frame axially located between first and second turbines of first and second rotors

respectively,

said first turbine located forward of said second turbine,

5 said second rotor includes a second shaft which is at least in part rotatably disposed co-axially with and radially inwardly of said first rotor,

said inter-turbine frame comprising;

a first structural ring,

10 a second structural ring disposed co-axially with and radially spaced inwardly of said first structural ring about a centerline axis,

a plurality of circumferentially spaced apart struts extending radially between said first and second structural rings,

15 forward and aft sump members having forward and aft central bores,

said forward and aft sump members fixedly joined to forward and aft portions of said turbine frame respectively,

20 said second rotor supported by a respective aftwardmost second turbine frame bearing mounted in said aft central bore of said aft sump member,

25 said first rotor partly supported by a respective first turbine frame bearing mounted in said forward central bore of said forward sump member, and

a frame connecting means for connecting said engine to an aircraft located on said first structural ring.

30 6. An assembly as claimed in claim 5 wherein an axial center of gravity of said second turbine passes though or very near said second turbine frame bearing.

7. An assembly as claimed in claim 5 wherein said second turbine includes a turbine disk assembly comprising axially adjacent rotor disks interconnected by structural disk forward and aft
5 spacer arms, respectively, and said turbine disk assembly is connected to said first shaft at or near said axial center of gravity.

8. An assembly as claimed in claim 7 further comprising a conical shaft extension drivingly
10 connected to said turbine disk assembly to said first shaft and said conical shaft extension connected to said turbine disk assembly at or near said axial center of gravity.

9. An assembly as claimed in claim 8 wherein said
15 turbine disk assembly further comprises said rotor disks having pluralities of hubs connected to rims by webs extending radially outwardly from said hubs each of said rotor disks supports a row of blades supported in said disk rim.

20 10. A frame as claimed in claim 9 wherein said forward and aft central bores are cylindrical.

11. A frame as claimed in claim 9 wherein said frame connecting means includes at least one U-shaped clevis.

25 12. A frame as claimed in claim 11 wherein said forward and aft central bores are cylindrical.

13. An aircraft gas turbine engine assembly comprising:

an inter-turbine frame axially located between

high and low pressure turbines of high and low pressure rotors respectively,

said high pressure turbine located forward of said low pressure turbine,

5 said low pressure rotor includes a low pressure shaft which is at least in part rotatably disposed co-axially with and radially inwardly of said high pressure rotor,

said inter-turbine frame comprising;

10 a first structural ring,

a second structural ring disposed co-axially with and radially spaced inwardly of said first structural ring about a centerline axis,

15 a plurality of circumferentially spaced apart struts extending radially between said first and second structural rings,

forward and aft sump members having forward and aft central bores,

20 said forward and aft sump members fixedly joined to forward and aft portions of said turbine frame respectively,

said second rotor supported by a respective aftwardmost second turbine frame bearing mounted in said aft central bore of said aft sump member,

25 said low pressure rotor partly supported by a respective first turbine frame bearing mounted in said forward central bore of said forward sump member, and

30 a frame connecting means for connecting said engine to an aircraft located on said first structural ring.

14. An assembly as claimed in claim 13 wherein said aft sump member has a first radius as measured from said engine centerline axis that is substantially

greater than a second radius of said forward sump members.

15. An assembly as claimed in claim 14 wherein said first radius a range of 150 to 250 percent larger
5 than said second radius.

16. An assembly as claimed in claim 13 wherein said low pressure turbine has an axial center of gravity that passes though or very near said second turbine frame bearing.

10 17. An assembly as claimed in claim 16 wherein said low pressure turbine includes a turbine disk assembly comprising axially adjacent rotor disks interconnected by structural disk forward and aft spacer arms, respectively, and said turbine disk
15 assembly is connected to said low pressure shaft at or near said axial center of gravity.

18. An assembly as claimed in claim 17 further comprising a conical shaft extension drivingly connected to said turbine disk assembly to said first
20 shaft and said conical shaft extension connected to said turbine disk assembly at or near said axial center of gravity.

19. An assembly as claimed in claim 18 wherein said turbine disk assembly further comprises said disks
25 having pluralities of hubs connected to rims by webs extending radially outwardly from said hubs each of said rotor disks supports a row of blades supported in said disk rim.

20. An assembly as claimed in claim 19 wherein said
aft sump member has a first radius as measured from
said engine centerline axis that is substantially
greater than a second radius of said forward sump
5 members.

21. An assembly as claimed in claim 20 wherein said
first radius a range of 150 to 250 percent larger
than said second radius.

22. A frame as claimed in claim 21 wherein said
10 frame connecting means includes at least one U-shaped
clevis.

23. An aircraft gas turbine engine assembly
comprising:

only two axially spaced apart forward and aft
15 frames rotatably supporting co-axial first and second
rotors,

each of said frames comprising a first
structural ring and a second structural ring, said
second structural ring disposed co-axially with and
20 radially spaced inwardly of said first structural
ring about a centerline axis, and a plurality of
circumferentially spaced apart struts extending
radially between said first and second structural
rings,

25 a first shaft of said second rotor disposed
radially inwardly of said first rotor,

said aft frame located between turbines of said
first and second rotors, and

forward and aft frame connecting means for
30 connecting said engine to an aircraft disposed on
said forward and aft frames.

24. An aircraft gas turbine engine assembly comprising:

- 5 axially spaced apart fan and inter-turbine frames rotatably supporting co-axial high and low pressure rotors,
 - each of said frames comprising a first structural ring and a second structural ring, said second structural ring disposed co-axially with and radially spaced inwardly of said first structural
 - 10 ring about a centerline axis, and a plurality of circumferentially spaced apart struts extending radially between said first and second structural rings,
 - said inter-turbine frame axially located between
 - 15 high and low pressure turbines of said high and low pressure rotors respectively,
 - said high pressure turbine located forward of said low pressure turbine,
 - said low pressure rotor includes a low pressure
 - 20 shaft which is at least in part rotatably disposed co-axially with and radially inwardly of said high pressure rotor,
 - forward and aft sump members having forward and aft central bores,
 - 25 said forward and aft sump members fixedly joined to forward and aft portions of said turbine frame respectively,
 - said low pressure rotor supported by a respective aftwardmost second turbine frame bearing
 - 30 mounted in said aft central bore of said aft sump member,
 - said low pressure rotor partly supported by a respective first turbine frame bearing mounted in said forward central bore of said forward sump
 - 35 member, and

a frame connecting means for connecting said engine to an aircraft located on said first structural ring.

5 25. An assembly as claimed in claim 24 wherein said aft sump member has a first radius as measured from said engine centerline axis that is substantially greater than a second radius of said forward sump members.

10 26. An assembly as claimed in claim 25 wherein said first radius a range of 150 to 250 percent larger than said second radius.

15 27. An assembly as claimed in claim 24 wherein said low pressure turbine has an axial center of gravity and is connected to said low pressure shaft at or near said second turbine frame bearing.

20 28. An assembly as claimed in claim 27 wherein said low pressure turbine includes a turbine disk assembly comprising axially adjacent rotor disks interconnected by structural disk forward and aft spacer arms, respectively, and said turbine disk assembly is connected to said low pressure shaft at or near said axial center of gravity.

25 29. An assembly as claimed in claim 28 further comprising a conical shaft extension drivingly connected to said turbine disk assembly to said first shaft and said conical shaft extension connected to said turbine disk assembly at or near said axial center of gravity.

30. An assembly as claimed in claim 29 wherein said turbine disk assembly further comprises said disks having pluralities of hubs connected to rims by webs extending radially outwardly from said hubs each of said rotor disks supports a row of blades supported in said disk rim.

31. An assembly as claimed in claim 30 wherein said aft sump member has a first radius as measured from said engine centerline axis that is substantially greater than a second radius of said forward sump members.

32. An aircraft gas turbine engine assembly comprising:
axially spaced apart fan and inter-turbine frames rotatably supporting co-axial high and low pressure rotors,
each of said frames comprising a first structural ring and a second structural ring, said second structural ring disposed co-axially with and radially spaced inwardly of said first structural ring about a centerline axis, and a plurality of circumferentially spaced apart struts extending radially between said first and second structural rings,
said inter-turbine frame axially located between high and low pressure turbines of said high and low pressure rotors respectively,
said high pressure turbine located forward of said low pressure turbine,
said low pressure rotor includes a low pressure shaft which is at least in part rotatably disposed co-axially with and radially inwardly of said high pressure rotor,

aft sump member having an aft central bore
fixedly joined to said turbine frame,

5 said low pressure rotor supported by an
aftwardmost second bearing mounted in said aft
central bore of said aft sump member,

 said high pressure rotor partly supported by a
differential bearing mounted in an annular recess
that is located radially inwardly of said second
bearing,

10 said annular recess extends axially aftward into
a radially enlarged portion of said aft end, and
 a frame connecting means for connecting said
engine to an aircraft located on said first
structural ring.

15 33. An assembly as claimed in claim 32 wherein said
low pressure turbine has an axial center of gravity
and is connected to said low pressure shaft at or
near said second turbine frame bearing.

20 34. An assembly as claimed in claim 33 wherein said
low pressure turbine includes a turbine disk assembly
comprising axially adjacent rotor disks
interconnected by structural disk forward and aft
spacer arms, respectively, and said turbine disk
assembly is connected to said low pressure shaft at
25 or near said axial center of gravity.

30 35. An assembly as claimed in claim 34 further
comprising a conical shaft extension drivingly
connected to said turbine disk assembly to said first
shaft and said conical shaft extension connected to
said turbine disk assembly at or near said axial
center of gravity.

36. An assembly as claimed in claim 35 wherein said turbine disk assembly further comprises said disks having pluralities of hubs connected to rims by webs extending radially outwardly from said hubs each of
5 said rotor disks supports a row of blades supported in said disk rim.